

Monitoring for Saving

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Energy Efficiency &
Renewable Energy

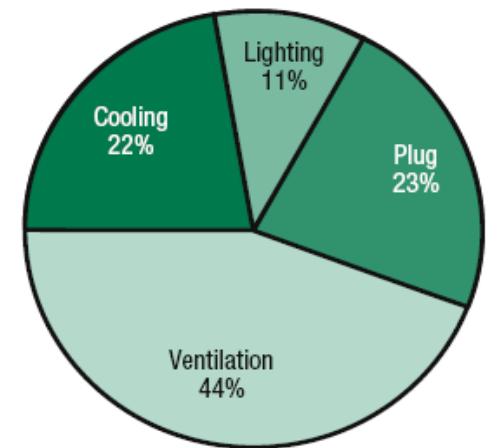
Use of Labs 21 tools and monitoring systems in exploring energy savings opportunities in laboratories, a case study

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Lawrence Berkeley National Laboratory
September, 2013



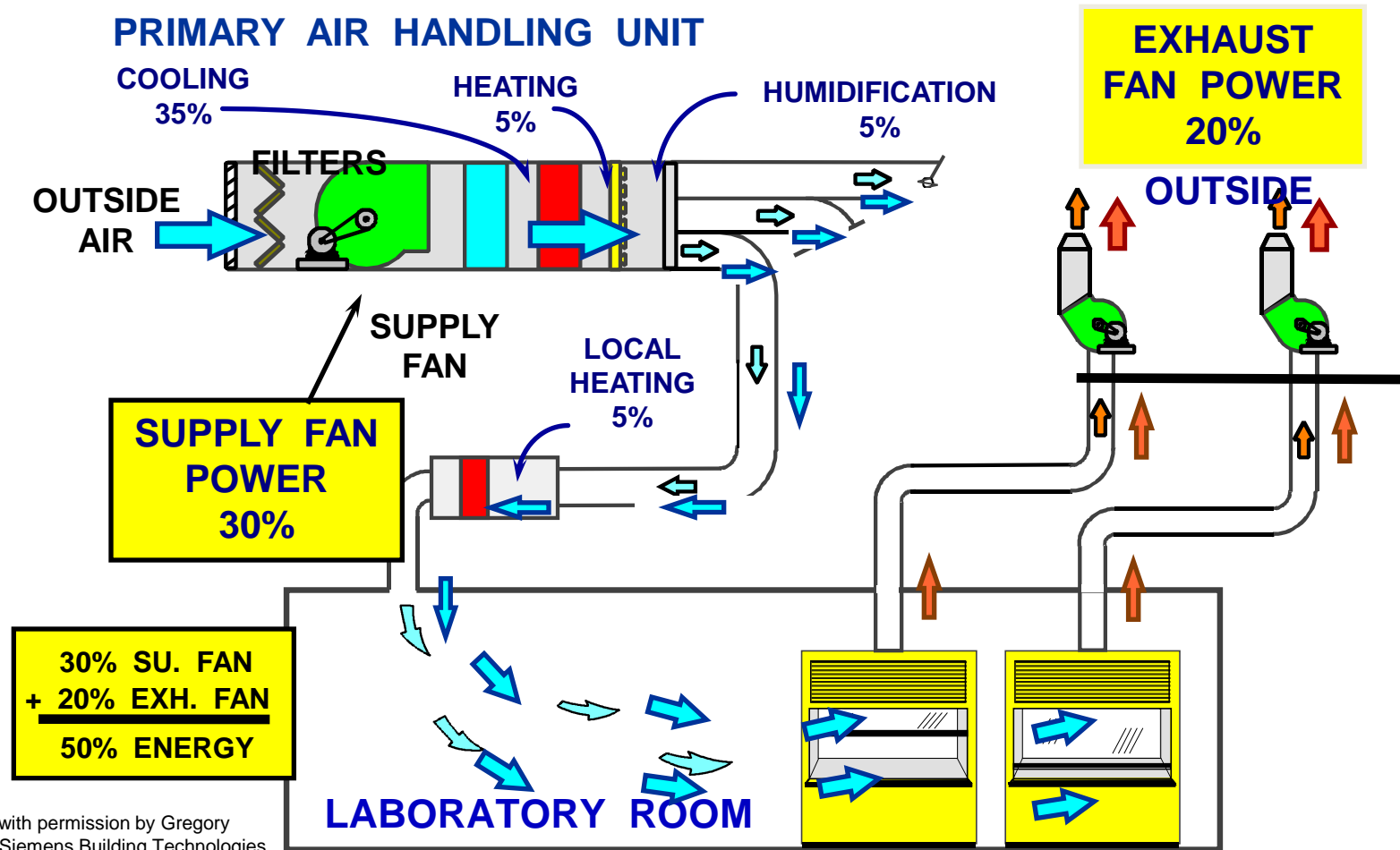
Objectives: At the end of this session, after a brief review of laboratory ventilation and HVAC basics you :

- 1. Become familiar with the benefits of use of benchmarking and LEEP tools in discovering energy end use**
- 2. Become familiar with benefits of the laboratory central monitoring and control systems**
- 3. Discovering EEMs in a case study**
 - 1. Optimize Ventilation (air change) Rates**
 - Lower HVAC Fan-Energy Use
 - Lower cooling and heating with make up air reduction
 - 2. Minimize Simultaneous Heating and Cooling**



Annual electricity use in Louis Stokes Laboratory, National Institutes of Health , Bethesda, MD

Basic Lab HVAC System



Adapted with permission by Gregory DeLuga, Siemens Building Technologies, Inc.

What is the Minimum, Safe Air Ventilation Rate?

- Few codes but many standards
 - Ventilation standards often expressed as a range (e.g. 4 to 12 air changes)
- According to IBC building codes:
 - IBC B occupancy requires ventilation based on people
 - IBC H-5 occupancy requires 1 cfm/sf of outside air.
- 1 cfm/sf translates to 6 air changes per hour (ACH) with a 10 foot ceiling.



Optimize Ventilation Rate

Strategy 1: Apply occupied versus unoccupied ventilation rates.

- Automate setback with control strategies.
- Zone proximity sensors
- Can be simple interlock with light switch.
- Sash stop

Strategy 2: Apply VAV exhaust and supply.



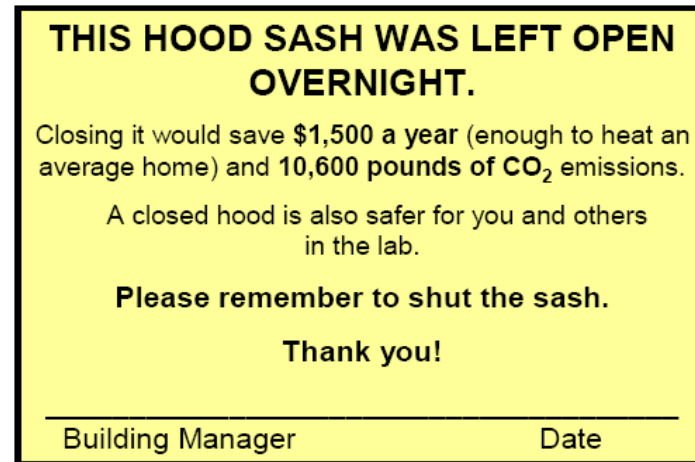
Recognize User Influence

- Users have great influence on **both** safety and energy efficiency.
- For example, VAV exhaust systems are useless when operators do not use it as intended; **close sash** when not in use.
- Comprehensive and reoccurring **training** is required.



Sash management

- Training and education
- Feedback to users
 - The stick
 - The carrot
- Automated sash management
 - Occupied and unoccupied set points (reset velocity set point)
 - Auto sash closure system
- Continuous improvement
 - Follow up regularly



Courtesy of Harvard Green Campus Initiative

*Courtesy of Allen
Doyle, UC Davis*

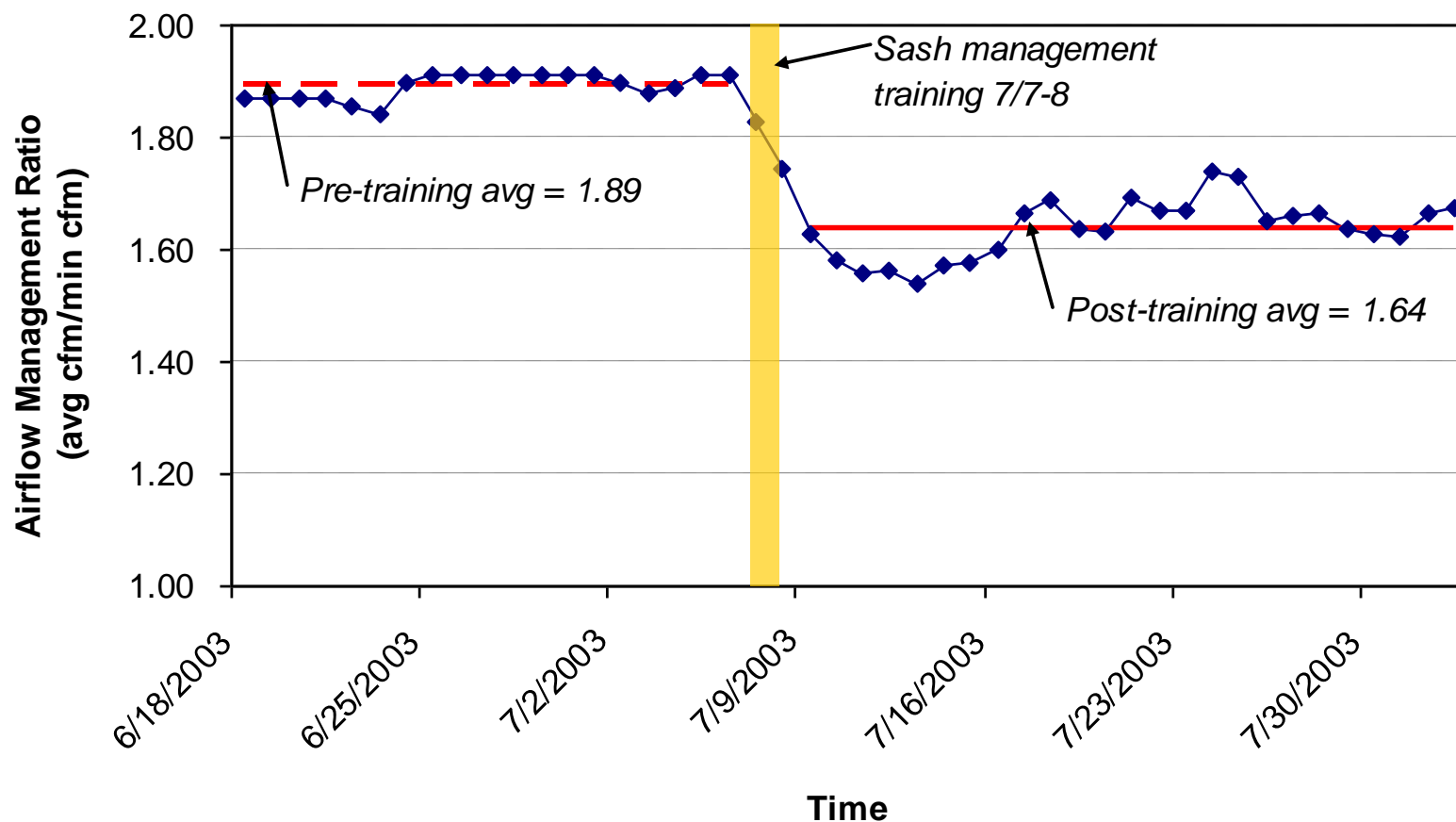


Impact of Sash Management Training

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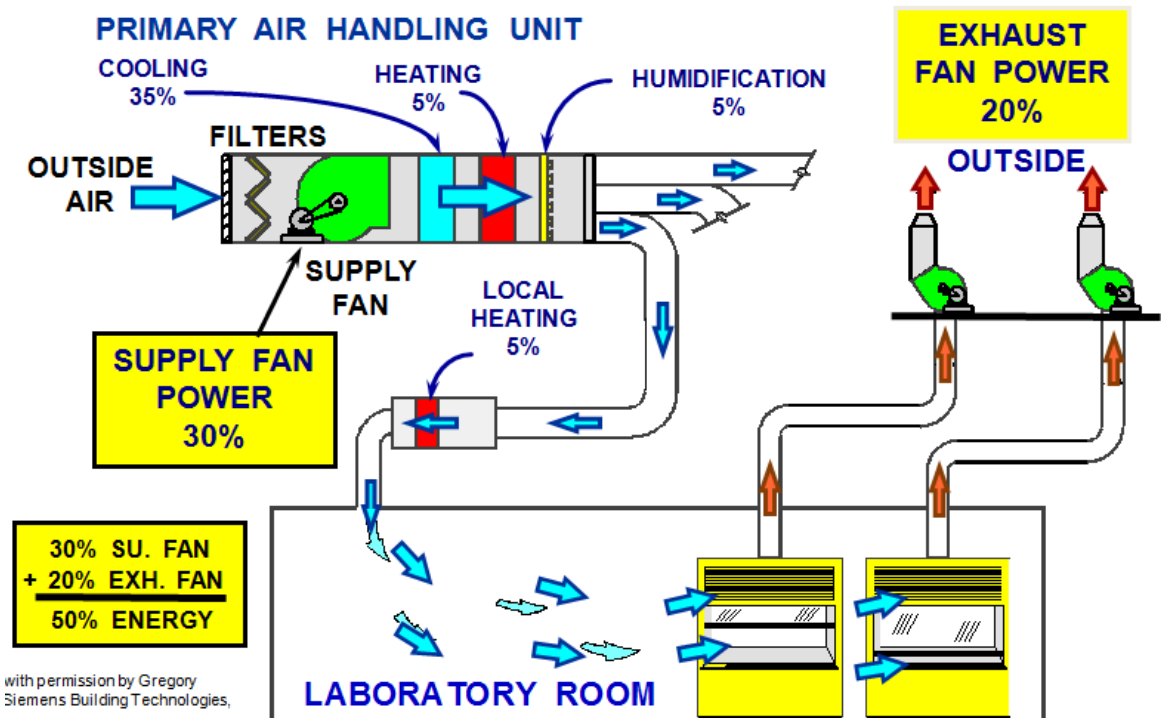
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**Impact of Sash Management Training on Airflow Ratio
Duke University Lab Module**



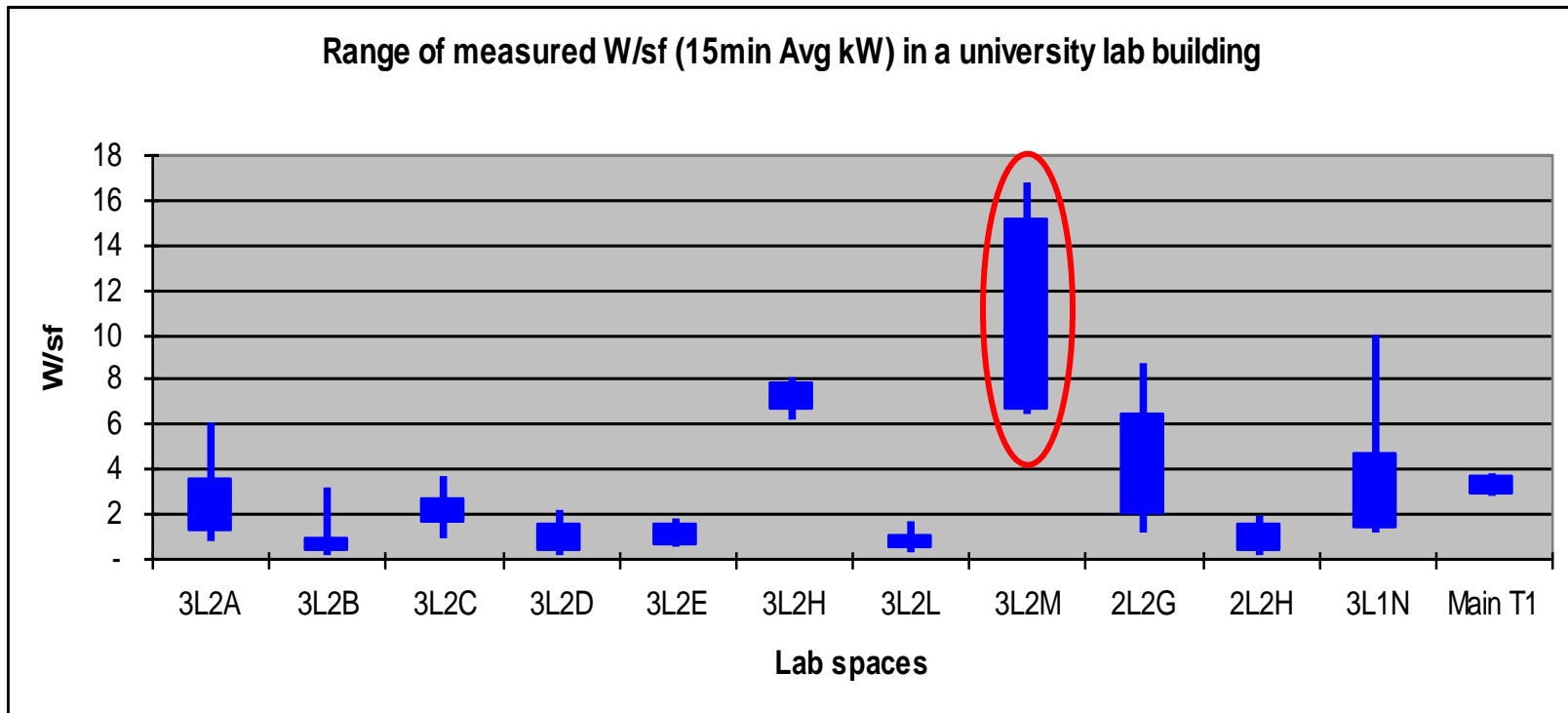
What is Simultaneous Heating and Cooling?

- Consider *only one* of many labs having a large, unanticipated, heat-generating load.
- HVAC system will provide cooler air to satisfy this higher-intensity lab.
- Consequently, all other lab spaces must be *re-heated*, after airflow has been expensively cooled.



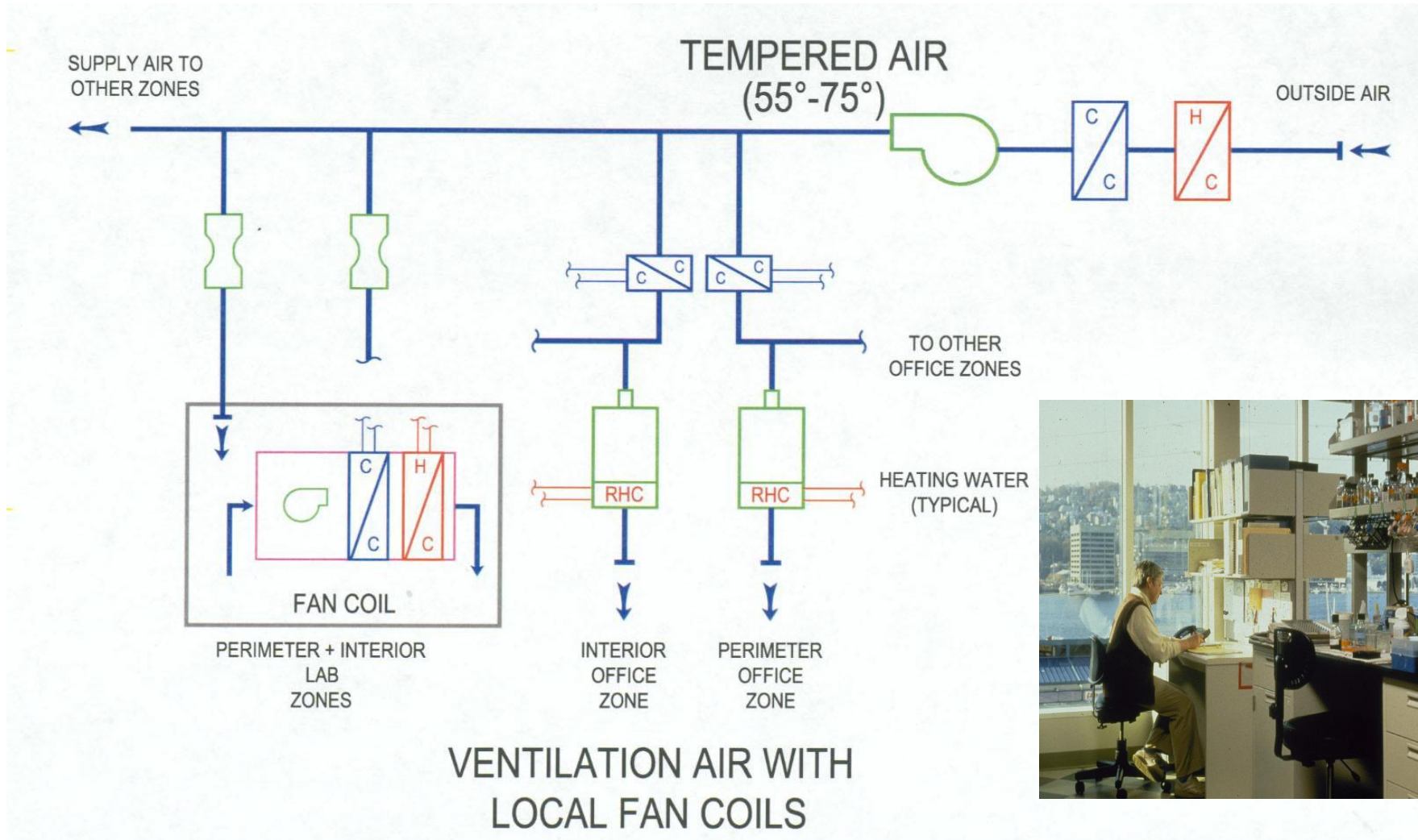
➤ Reheat (simultaneous heating and cooling) causes major energy waste in labs

- A single high load lab zone requiring cooling can artificially create reheating loads throughout remainder of laboratory...



Courtesy of UC Davis

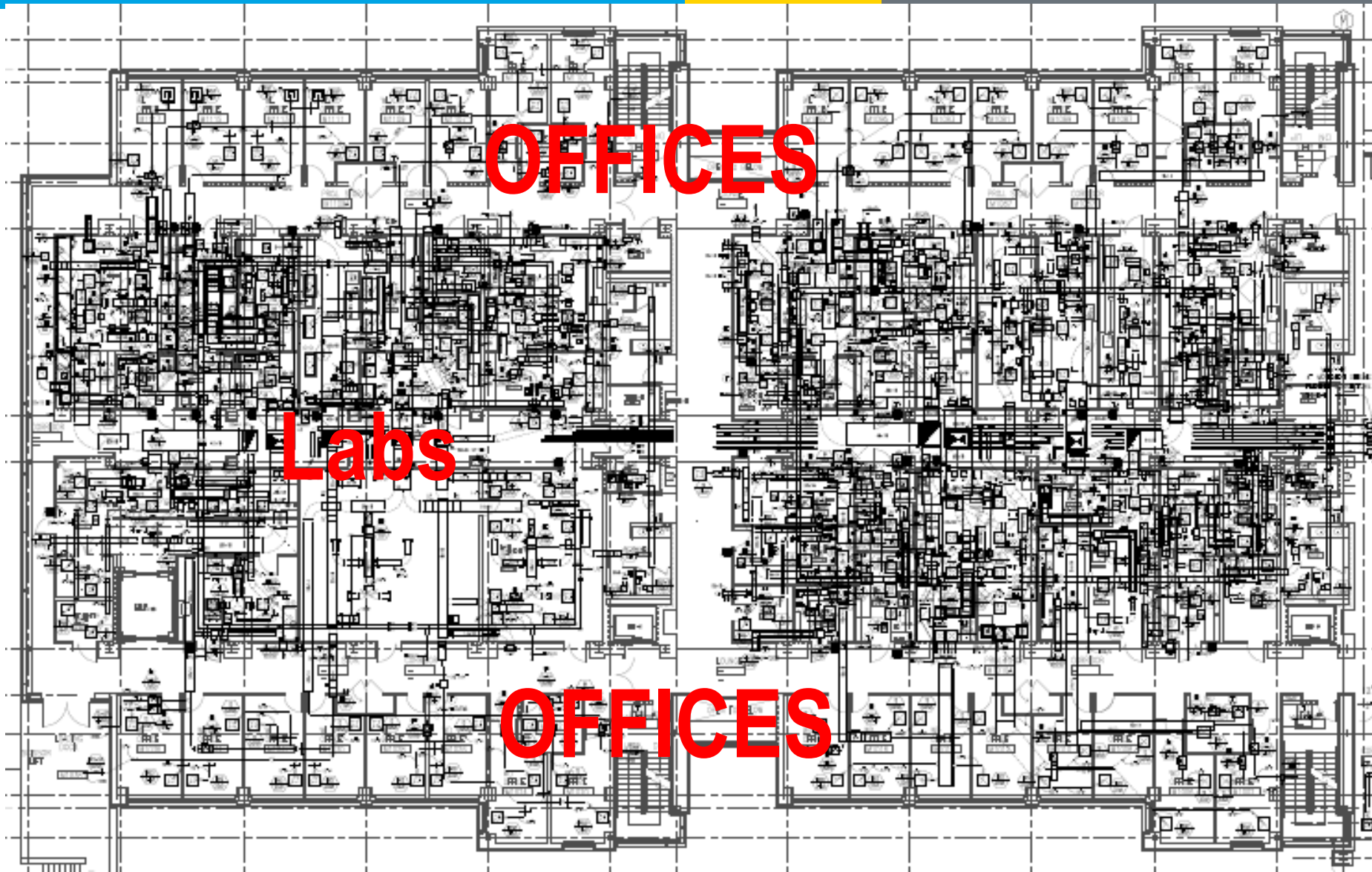
Separate ventilation from cooling to minimize reheat...



Case study - B15

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Hoods in B15, efficiency opportunities



**canopy hoods,
seldom used**



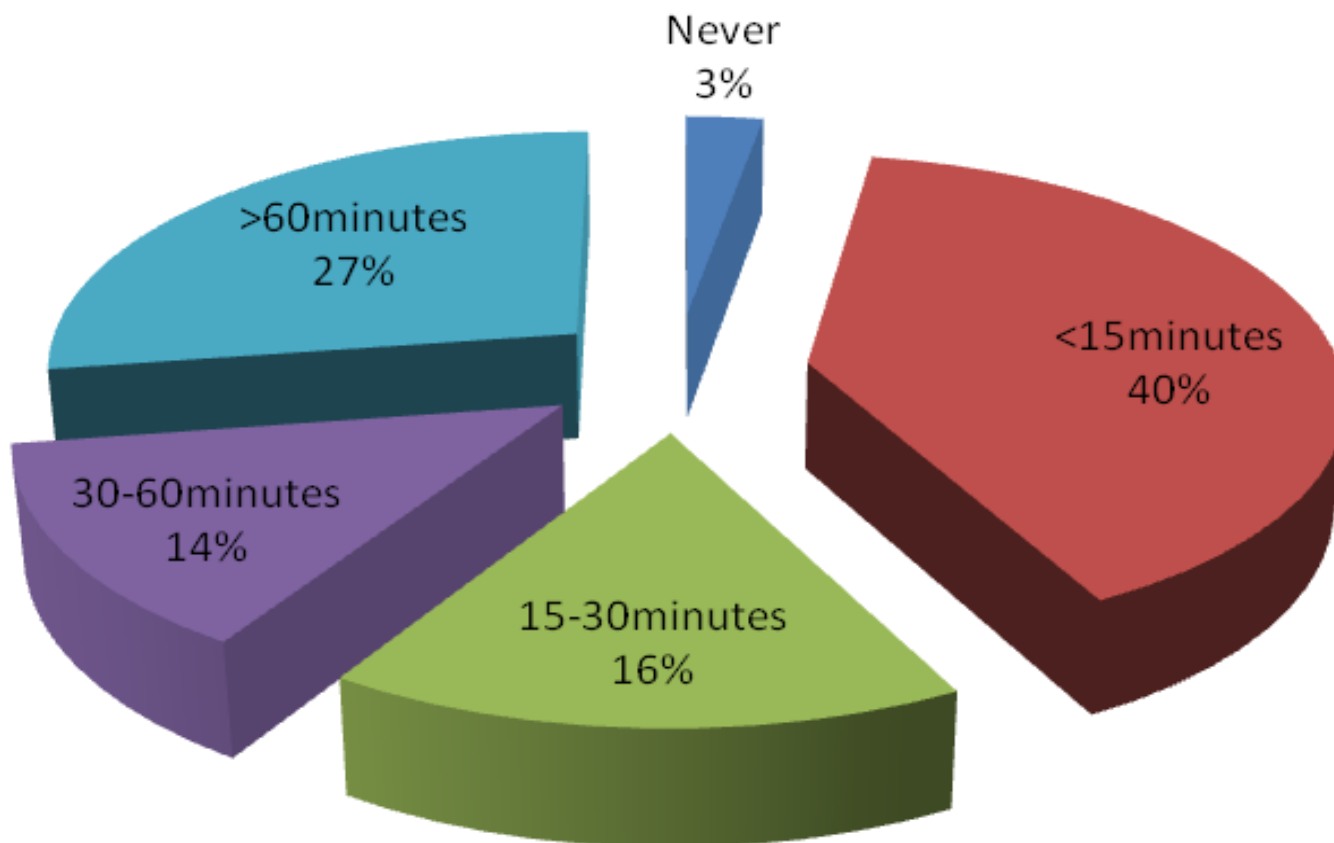
Open sash hood



No sash

Courtesy of ETC

Percent of fume hood use in B15, minutes per day



LABS FOR THE 21ST CENTURY

benchmarking

step one of four - login

step two of four - enter facility name and year of data

step three of four - enter data for the facility

step four of four - review / edit entered data

Welcome rmahdavi
Organization - LBNL

Please select the following




Facility name

Year for which data is being entered

Enter Facility Data...

Your Current Data:

General Facility Data








User	rmahdavi		
Organization	LBNL		
Facility Name	<input type="text"/>		
Year (for which this data applies)	2012		
Street Address*	<input type="text"/>		
Location*	<input type="text"/>		
Zip Code (5 digit)*	<input type="text"/>		
Organization Type *	Other ▼		
Lab Use (most prevalent)*		Research/Development ▼	
Lab Type (most prevalent)*		Chemical ▼	
Number of Buildings*	<input type="text" value="1"/>		
Gross Area (sq. ft.)*		<input type="text" value="200000"/>	

Whole Building Energy Use Data

*(The Energy use and cost data entered in this section should include ALL energy used by the building, including district steam / hot water / chilled water if applicable.
Enter 0 if not applicable)*

More Information

Measured / Estimated

Annual Electric Use (kWh)* 	<input type="text" value="4200000"/>	<input checked="" type="radio"/>	<input type="radio"/>
Peak Electric Demand (kW)	<input type="text" value="800"/>	<input type="radio"/>	<input checked="" type="radio"/>
Annual Natural Gas Use (Million BTU)* 	<input type="text" value="35000"/>	<input type="radio"/>	<input checked="" type="radio"/>
Annual Fuel Oil Use (Million BTU)* 	<input type="text" value="0"/>	<input type="radio"/>	<input checked="" type="radio"/>
Annual Other Fuel Use* (Million BTU) 	<input type="text" value="0"/>	<input type="radio"/>	<input checked="" type="radio"/>
Annual District Chilled Water Use* (Million BTU) 	<input type="text" value="0"/>	<input type="radio"/>	<input checked="" type="radio"/>
Annual District Hot Water Use* (Million BTU) 	<input type="text" value="0"/>	<input type="radio"/>	<input checked="" type="radio"/>
Annual District Steam Use* (Million BTU) 	<input type="text" value="0"/>	<input type="radio"/>	<input checked="" type="radio"/>
Annual Energy Utility Cost (\$)	<input type="text" value="690000"/>	<input type="radio"/>	<input checked="" type="radio"/>

Ventilation System Energy Use Data

Measured / Estimated

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benchmarking

step one of four - login

step two of four - enter facility name and year of data

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step four of four - review / edit entered data

General Facility Data

User	rmahdavi
Organization	LBNL
Facility Name	USGS
Year (for which this data applies)	2012
Street Address	345 middlefield rd
Location	Menlo Park, ca
Zip Code	94025
Organization Type	Other
Lab Use (most prevalent)	ResearchDevelopment
Lab Type (most prevalent)	Chemical
Number of Buildings	1
Gross Area (sf)	200000
Lab Area (sf)	40000
% Biological	10
% Chemical	80
% Physical	10
% Other	0
Vivarium Area (sf)	0
Number of Fumehoods	100
Total linear feet of Fumehoods	360
Total occupancy hours per week	60
Total Number of Occupants	180
Year Built (or major reNovations)	1996
Is this an existing building?	Yes - Existing Building

Lab Indoor Design Conditions

Occupied Cooling Setpoint (F)	72
Occupied Heating Setpoint (F)	72
Unoccupied Cooling Setpoint (F)	70
Unoccupied Heating Setpoint (F)	68
Humidity Minimum (%RH)	20
Humidity Maximum (%RH)	80

High Performance Features

HVAC

VAV Fumehoods -	VFD for Fans/Motors - yes
High Efficiency Chiller Plant -	High Efficiency Heating Plant -
Thermal Energy Storage -	Automated Control Systems -
Energy Recovery -	Low Pressure Air Distribution -
No reheat -	Others -

Lighting

Day Lighting Systems -	High Efficiency Lamps/Fixtures -
Automated Controls -	Others -

Envelope

High Performance Glass -	External Shading Devices -
Others -	

Others

Facility uses CHP (Cogen) system	Others -
----------------------------------	----------

Additional Comments

Edit Data For This Facility

Benchmarking Analysis

Enter Data For Another Facility

Log out

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benchmarking

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High Performance Features

Edit Data For This Facility

Benchmarking Analysis

Enter Data For Another Facility

Log out

Lab Type (most prevalent)	Chemical
Number of Buildings	1
Gross Area (sf)	200000
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% Biological	10
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% Other	0
Vivarium Area (sf)	0
Number of Fumehoods	100
Total linear feet of Fumehoods	360
Total occupancy hours per week	60
Total Number of Occupants	180
Year Built (or major reNovations)	1996
Is this an existing building?	Yes - Existing Building

High Performance Glass -

Others -

Others

Facility uses CHP (Cogen) system

Additional Comments

External Shading Devices -

Others -

Edit Data For This Facility

Benchmarking Analysis

Enter Data For Another Facility

Log out

benchmarking

Choose Metrics and Filtering Criteria

[More Information](#)

User **rmahdavi**

Organization **LBL**

Select metric:

System

Cooling

Energy / Efficiency Metric

kWh/gsf-yr

Specify data filtering criteria:

1. Lab Area / Gross Area ratio 

is greater than or equal to

and is less than or equal to

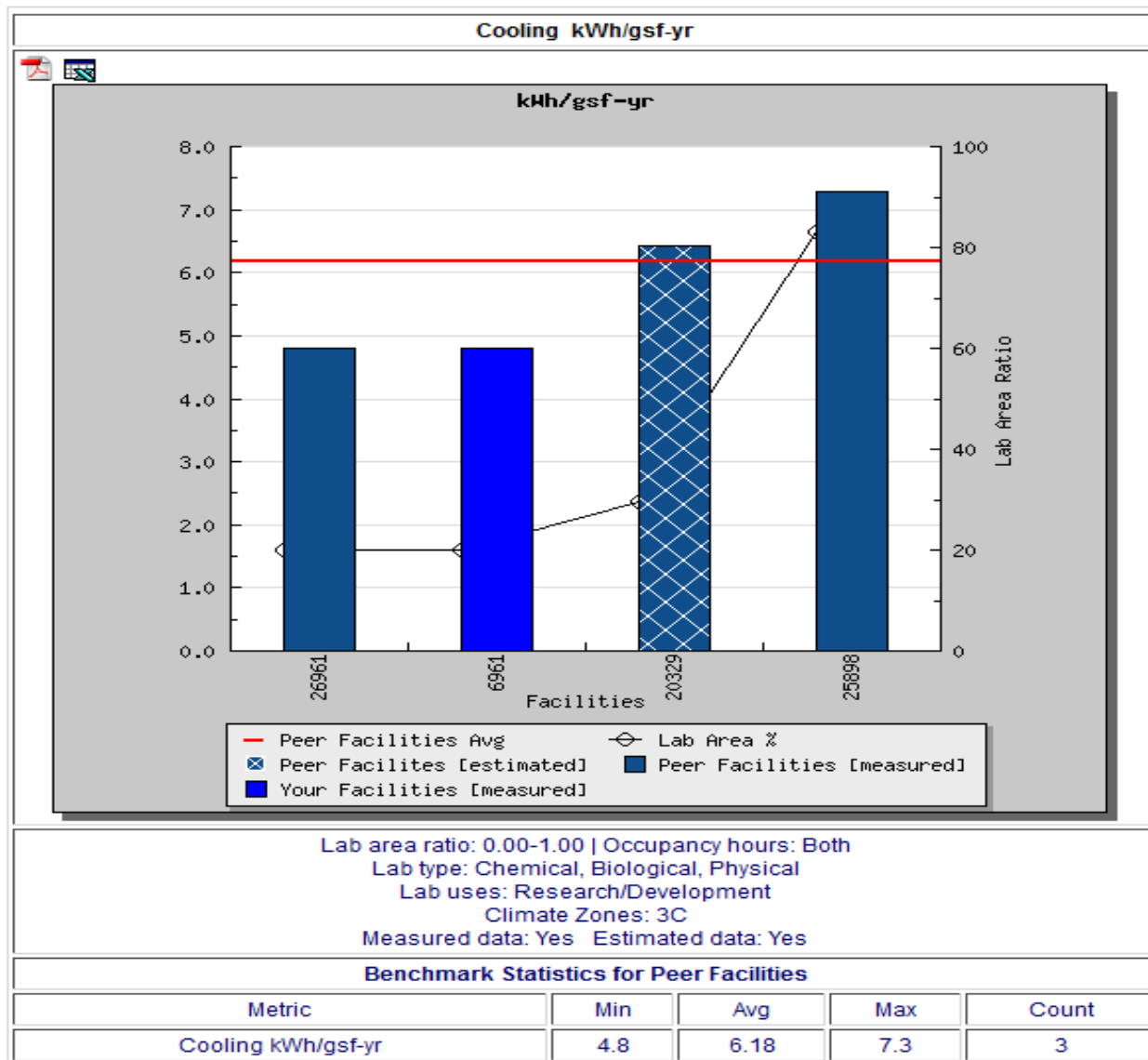
2. Occupancy hours per week 

☐ Standard (≤ 80 hours)

☐ High (> 80 hours)

☒ Both (all data)

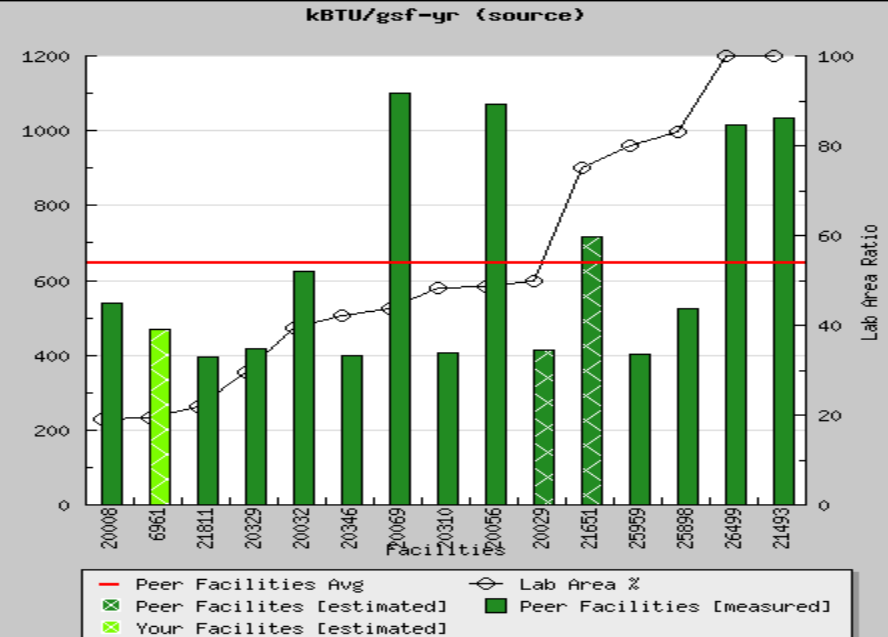
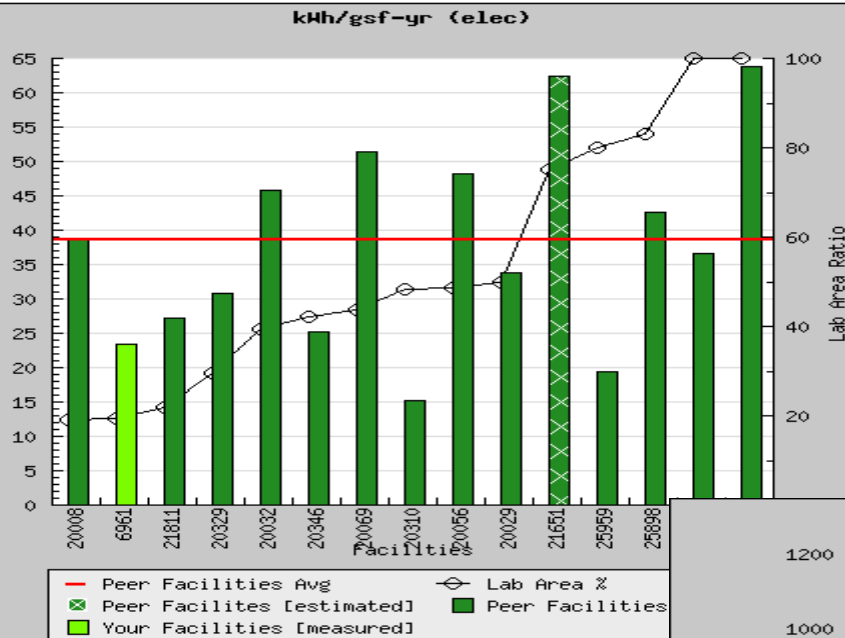
LABS 21 Benchmarking Tool



Click titles of columns below to sort
Data for your facilities are highlighted | Estimated data are indicated in *italics*

LABS 21 Benchmarking Tool

Case Study Results



Lab Energy Efficiency Profiling Tool

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LABORATORY ENERGY EFFICIENCY PROFILER



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IDENTIFY POTENTIAL ENERGY EFFICIENCY OPPORTUNITIES IN YOUR LABORATORY

LABORATORY ENERGY EFFICIENCY PROFILER (LEEP)

helps users to quickly identify and prioritize potential energy efficiency actions in laboratory facilities. It does not require users to have any specialized knowledge of energy audits or analysis. The tool inputs are the key characteristics of the facility's ventilation, heating, cooling and lighting systems as well as plug and process equipment. Based on these inputs, the tool provides information on the relevance, impact, and comparative cost of over 60 actions to reduce energy use. These results can then be used to help establish the scope and priorities for more detailed energy audits.


Username

Password

Login


[Request A User Account](#)





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Before you begin:
Have you benchmarked your facility?

It is recommended that you first benchmark your facility before using LEEP. Benchmarking is the first step in profiling energy use and allows you identify and prioritize facilities with the greatest overall efficiency potential. This is especially useful if you have a portfolio of facilities.

[Continue with LEEP](#)

[Go to Benchmarking Tool](#)

☐ Do not show this screen again

Labs 21 LEEP Tool

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Select Facility | Select Assessment Scope | Input Facility Data | Review Actions

Click facility name to begin

Name	Last Updated
	2013-06-26

Add New Facility

Labs 21 LEEP Tool

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The image displays three overlapping screenshots of the Laboratory Energy Efficiency Profiler (LEEP) tool interface. The interface features a blue header with the LEEP logo, the title "LABORATORY ENERGY EFFICIENCY PROFILER", and a navigation bar with icons for different energy systems (wind, fire, water, sun). The main content area is divided into four steps: "Select Facility", "Select Assessment Scope", "Input Facility Data", and "Review Actions". The "Select Facility" step shows a list of facilities, including "USGS B15", and an "Add New Facility" button. The "Select Assessment Scope" step shows a table with columns for "Include" and "Exclude", listing "Ventilation", "Heating & Cooling", "Process Loads", and "Lighting", all of which are checked under the "Include" column. The "Input Facility Data" step is currently active, showing a large empty form area. The "Review Actions" step is the final step in the process.

LABORATORY ENERGY EFFICIENCY PROFILER

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Select Facility

Click facility name to select

USGS B15

Add New Facility

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Select Facility | Select Assessment Scope | Input Facility Data | Review Actions


	Include
Ventilation	<input checked="" type="checkbox"/>
Heating & Cooling	<input checked="" type="checkbox"/>
Process Loads	<input checked="" type="checkbox"/>
Lighting	<input checked="" type="checkbox"/>


Navigation arrows: Previous, Next

Labs 21 LEEP Tool

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[Select Facility](#) | [Select Assessment Scope](#) | [Input Facility Data](#) | [Review Actions](#)

[General](#) | [Ventilation](#) | [Heating & Cooling](#) | [Process & Plug Loads](#) | [Lighting](#)

*** Required**

Street address*

Location*

ZIP code (5 digit)*

Organization type* Government

Building gross area (gsf)* 200,000

Laboratory Area (nsf)* (Chemical and biological: "wet") 40,000

Occupied hours per week* 48

Year of construction* (or last major renovation) 1996

Climate zone* [Climate maps](#) (3C) Warm - Marine

Lab use (most prevalent)* Research/Development

Lab type (most prevalent)* Chemical

Vivarium area (sq. ft.)* 0

[Save and Continue](#)

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[Select Facility](#) > [Select Assessment Scope](#) > [Input Facility Data](#) > [Review Actions](#)

[General](#) | **[Ventilation](#)** | [Heating & Cooling](#) | [Process & Plug Loads](#) | [Lighting](#)

No required fields. Leave blank or select 'Don't Know' if unknown.

Building ventilation system type	Variable Air Volume (VAV) ▾
▼Supply System	
Peak/max. building supply airflow (CFM)	140,000
Peak/max. lab-only supply airflow (CFM)	100,000
Minimum lab-only supply airflow (CFM)	50,000
Supply total system pressure (TSP) drop (inches w.g.) ⓘ	4.0
What is the age of your oldest supply fan motor?(years)	15
Efficiency of fan motors nearing replacement (rating)	Standard ▾
How many times each year are fan motor belts changed? (Enter zero for direct drive fans)	0
Is there a temporary pre-filter remaining in the main AHU?	No ▾
Main filter type	Pleated ▾
Main filter pressure drop (inches w.g.)	1.0
Were the filters inspected within the last six months?	Yes ▾
Have the supply air handling units been checked for airflow obstructions and blockage?	Yes ▾
Do the supply air handling units have noise attenuators?	No ▾
Do the supply air handling units have acoustic lining?	Yes ▾
Do the supply air handling units have mesh guards around the fan(s)?	No ▾

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[Select Facility](#)
[Select Assessment Scope](#)
[Input Facility Data](#)
[Review Actions](#)

[General](#)
[Ventilation](#)
[Heating & Cooling](#)
[Process & Plug Loads](#)
[Lighting](#)


No required fields. Leave blank or select 'Don't Know' if unknown.


▼ **Heating System**

Is building heating from a district central system?	No
Number of boilers	2
Boiler input capacity (MMBTUH)	Boiler #1 20.0 Boiler #2 20.0
Boiler output capacity (MMBTUH)	Boiler #1 16.0 Boiler #2 16.0
Boiler turn down ratio (X to 1) ⁱ	Boiler #1 10 Boiler #2 10
What is the age of the heating plant (years)	15.0
What is the age of the oldest heating hot water pump motors? (years)	15.0
Heating Hot Water pump motor efficiency?	Standard
Does the heating hot water distribution system have variable speed pumps?	No
Is there an energy recovery system between the supply air duct and the exhaust air duct?	No

▼ **Cooling System**

Is building cooling from a district central system?	No
Number of chillers	2

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Select Facility > Select Assessment Scope > **Input Facility Data** > Review Actions

General Ventilation Heating & Cooling **Process & Plug Loads** Lighting


No required fields. Leave blank or select 'Don't Know' if unknown.

Are there procedures to shutdown process equipment when not in use?	<input type="text" value="No"/>
Are computers, monitors, and printers EnergyStar rated?	<input type="text" value="No"/>
Are there non-lab-grade refrigerators and freezers?	<input type="text" value="No"/>
Are there dedicated rooms for refrigerators and freezers?	<input type="text" value="No"/>
Are there centralized compressed air or vacuum pump systems?	<input type="text" value="Yes"/>
Where are centralized air compressors and vacuum pumps located?	<input type="text" value="Mechanical room"/>
Have compressed air and vacuum systems been checked for leaks within the last three years?	<input type="text" value="No"/>
Number of lab spaces requiring compressed air or vacuum	<input type="text" value="10"/>
Age of air compressor and vacuum pumps(years)	<input type="text" value="15.0"/>
Is there a dedicated chiller for process cooling?	<input type="text" value="No"/>
Is process chilled water temperature requirement within $\pm 10^{\circ}\text{F}$ of air conditioning chilled water temperature requirement?	<input type="text" value="Yes"/>

Save and Continue

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Select Facility > Select Assessment Scope > **Input Facility Data** > Review Actions

General Ventilation Heating & Cooling Process & Plug Loads **Lighting**

No required fields. Leave blank or select 'Don't Know' if unknown.

Laboratory lamp/ballast type	T8/Electronic (>10 yrs old) ▼
Fixture configuration in laboratory spaces	Direct-Indirect ▼
Ceiling height in laboratory spaces (ft.)	10
Ceiling configuration in laboratory spaces	Ceiling tiles ▼
Task illuminance level in laboratory spaces (footcandles)	40
Is there task lighting in the laboratory spaces?	No ▼
Do laboratory spaces have exterior windows?	No ▼
Is laboratory lighting controlled using occupancy sensors?	No ▼
Percentage of unoccupied labs with lights left on	30

Save and Continue

Labs 21 LEEP Tool



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Select Facility

Select Assessment Scope

Input Facility Data

Review Actions

[Print Actions Report](#)

High Likely Efficient
Big Medium Small
High \$\$\$ Medium \$\$ Low \$ Variable \$-\$\$\$
⊗ Not applicable
? Provide more information

Actions	Relevance	Impact	Cost	More Information
▼ Ventilation				
Optimize (reduce) lab exhaust ventilation rate to minimum.			\$-\$\$\$	Notes: Results based on minimum exhaust ventilation rate greater than 1.2 CFM/sq ft of net lab area Caution: Ability to reduce exhaust rate dependent on number of lab exhaust devices + Conversion from CV to VAV expensive Next Steps: Review lab exhaust system and device types for adjustment potential Less ▲
Optimize (reduce) exhaust ventilation rate to minimum during unoccupied periods			\$	Notes: Uses occupancy of less than 160 hours Caution: Ability to setback ventilation limited by AHJ + Ensure all stakeholders are included in setback scheme Next steps: Review action with AHJ for appropriateness + Monitor building operations to verify occupancy periods Less ▲
Optimize (reduce) supply ventilation rate.		⊗	⊗	
Optimize (reduce) number or size of hoods i.e. decommission some hoods.			\$\$\$	Notes: Are all lab exhaust devices used? Caution: Ability to alter ventilation devices limited by AHJ + Involve all stakeholders to determine alternatives Next steps: Review action with AHJ for appropriateness + Inventory lab device requirements + Decommission unused/misused devices Less ▲
Install direct digital control (DDC) system.		⊗	⊗	
Install variable volume fume hoods.		⊗	⊗	
Install low-flow fume hoods.	⊗	⊗	⊗	
Improve fume hood sash management.			\$-\$\$\$	Notes: Results based more than 25% hoods open and unoccupied Caution: Ability to reduce exhaust rate dependent on number and type of lab exhaust devices + Implementing sash management has a wide range of costs from manual-by-user (lowest) to automatic (highest) Next steps: Inventory number, size & type lab hoods + Begin with regular user sash management training and



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[VIEW RESULTS REPORT](#)

High

Likely

Efficient

Big

Medium

Small

High \$\$\$

Medium \$\$

Low \$

Variable \$-\$\$\$

⊗ Not applicable

? Provide more information

Actions

Relevance

Impact

Cost

More Information

▼ Ventilation

Optimize (reduce) lab exhaust ventilation rate to minimum.



\$-\$\$\$

Notes: Results based on minimum exhaust ventilation rate greater than 1.2 CFM/sq ft of net lab area
Caution: Ability to reduce exhaust rate dependent on number of lab exhaust devices + Conversion from CV to VAV expensive

[More...](#)

Install variable volume fume hoods.



Install low-flow fume hoods.



Improve fume hood sash management.



\$-\$\$\$

Notes: Results based more than 25% hoods open and unoccupied
Caution: Ability to reduce exhaust rate dependent on number and type of lab exhaust devices + Implementing sash management has a wide range of costs from manual-by-user (lowest) to automatic (highest)
Next steps: Inventory number, size & type lab hoods + Begin with regular user sash management training and rewards system + Determine effectiveness with BAS trending

Less ▲

Monitoring and control system - Niagra

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Building 15

Fire Alarm Stair 1

Normal

Fire Alarm Stair 2

Normal

Energy Dashboard

BTU Meters

OA Temperature

Gas Meters

Water Meter

Laboratory Airhandling Units

	Manual Disable	Supply Temp	Intake (OA) Temp	Cooling Valve	Heating Valve	Fan Status	
AHU1	Normal	55.3 °F	76.1 °F	100.0 %	0.0 %	Running	Zones
AHU2	Normal	54.5 °F	76.1 °F	43.2 %	0.0 %	Running	Zones
AHU3	Normal	56.2 °F	76.1 °F	100.0 %	0.0 %	Running	Zones
AHU4	Normal	56.9 °F	76.1 °F	100.0 %	0.0 %	Running	Zones
AHU5	Normal	54.9 °F	76.1 °F	25.6 %	0.0 %	Running	Zones
AHU6	Normal	54.2 °F	76.1 °F	39.9 %	0.0 %	Running	Zones

Library Airhandling Unit ⇨

	Occupied Command	Supply Temp	Mixed Air Temp	Cooling Valve	Heating Valve	Fan Status	
AHU7	true	56.7 °F	75.7 °F	54.9 %	0.0 %	Running	Zones

Boiler ⇨

Boiler 1 Cmd	Enabled
Boiler 2 Cmd	Disabled
HWP 1 Status	Running
HWP 2 Status	Stopped
Boiler 1 Temp	176.0 °F
Boiler 2 Temp	132.7 °F

Chiller and Cooling Tower ⇨

Chiller 1 Cmd	Enabled	CT1A Fan	Running
Chiller 2 Cmd	Disabled	CT1B Fan	Running
CHWP 1 Status	Stopped	CWP 1 Status	Running
CHWP 2 Status	Running	CWP 2 Status	Stopped
CHWP 3 Status	Stopped	CWP 3 Status	Stopped
Water Temp	49.0 °F	Water Temp	66.2 °F

Exhaust Fans ⇨

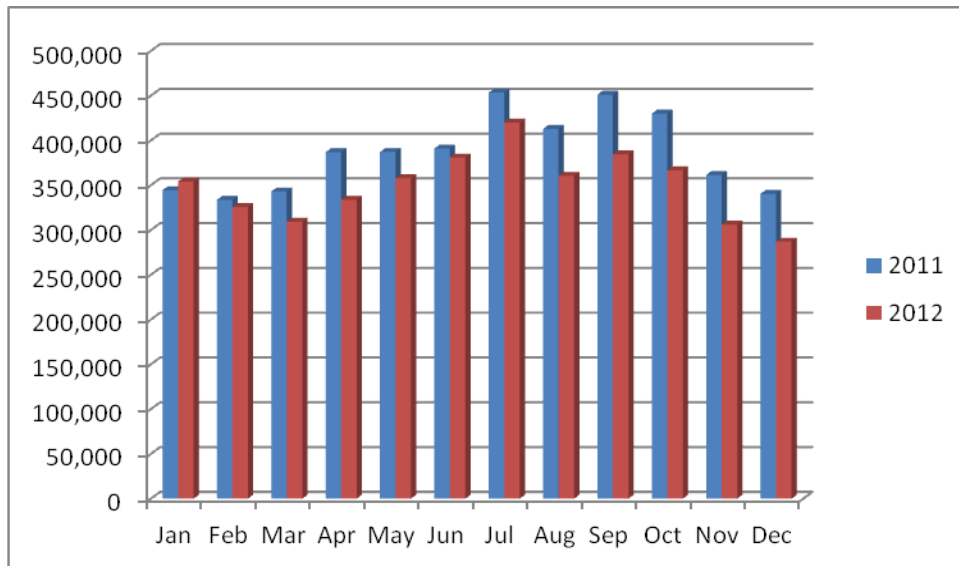
AHU1_2 System		AHU3_4 System		AHU5_6 System	
EF 1	Running	EF 5	Running	EF 9	Running
EF 2	Running	EF 6	Running	EF 10	Running
EF 3	Running	EF 7	Running	EF 11	Running
EF 4	Running	EF 8	Running	EF 12	Running

Miscellaneous Fans & EF-26 ⇨

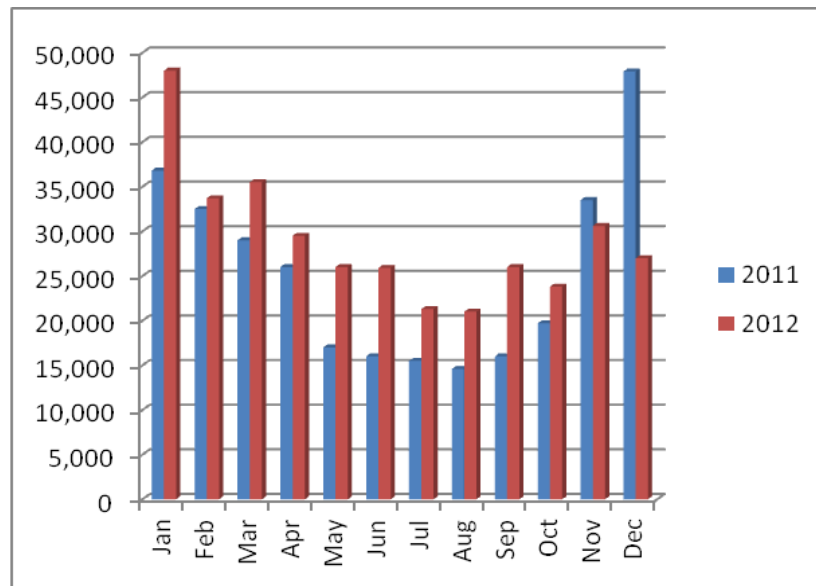
⇨ = hyperlink: Hotspot for jumping to associated equipment.

Power and gas use reduction 2011 to 2012

kWh



Therms



Monitoring and Control Equipment

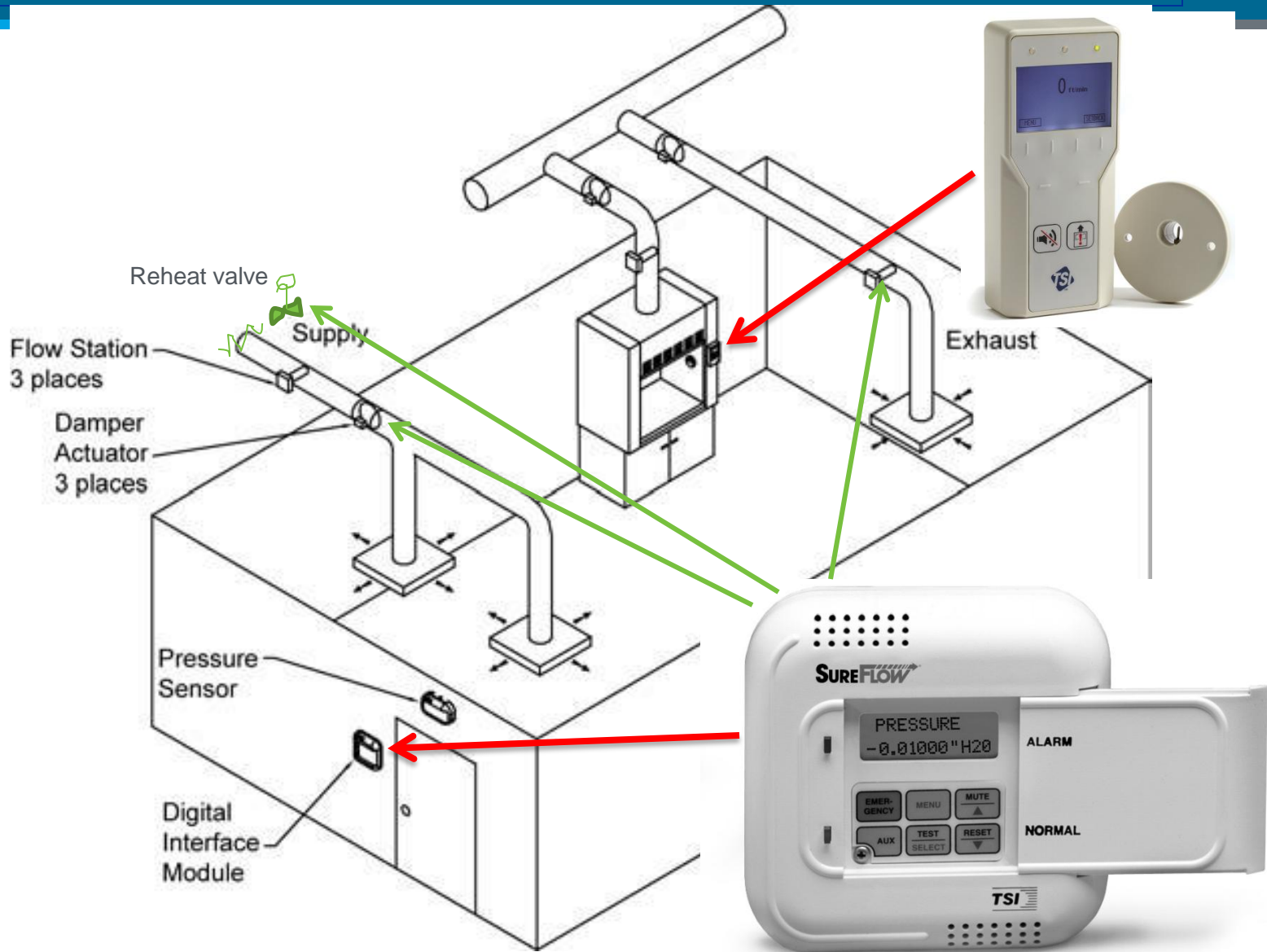
U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

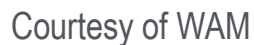


Courtesy of TSI and Honeywell

B15 Typical Lab Control



Energy Efficiency & Renewable Energy



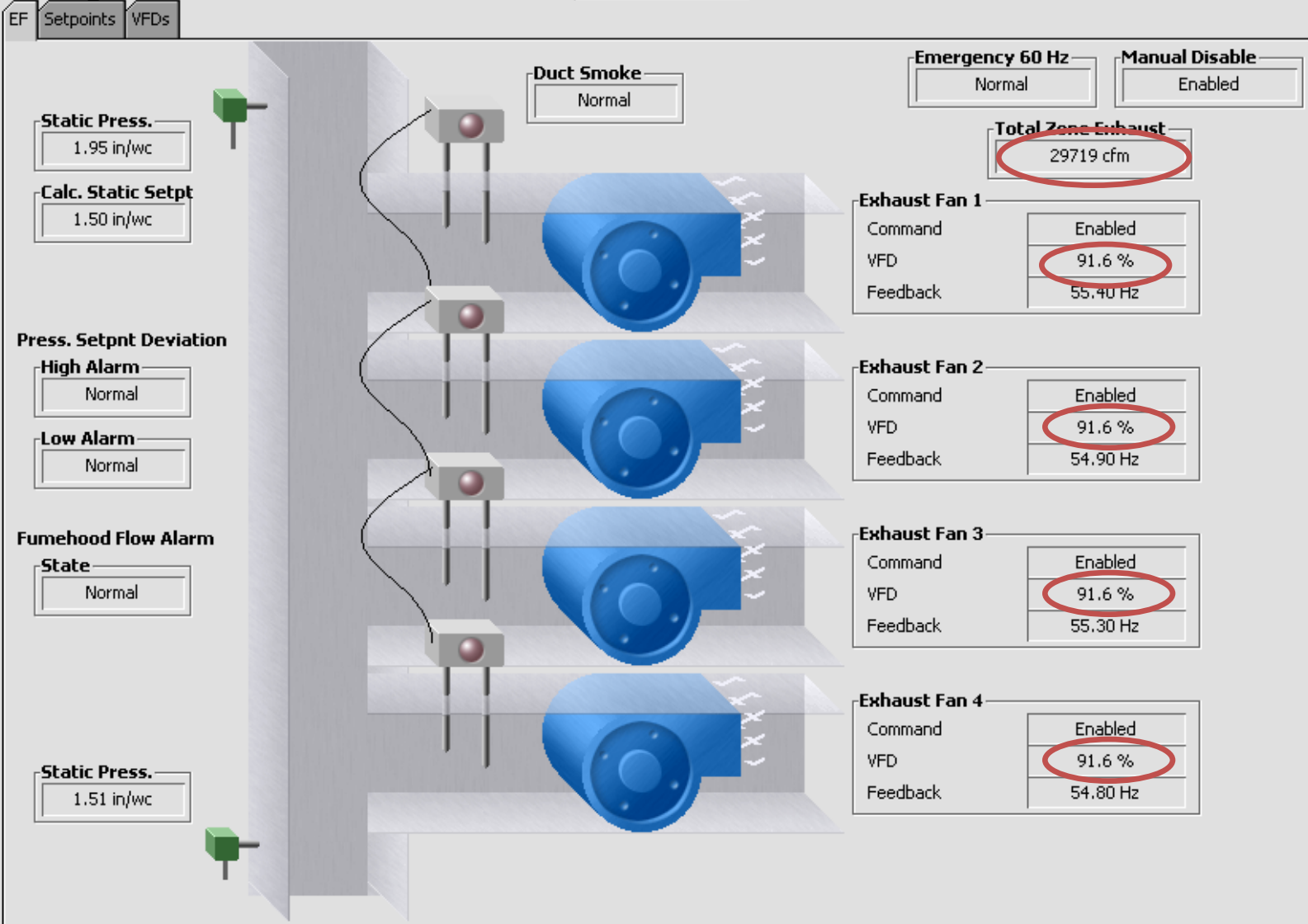
VFDs installed, opportunity?

Building 15

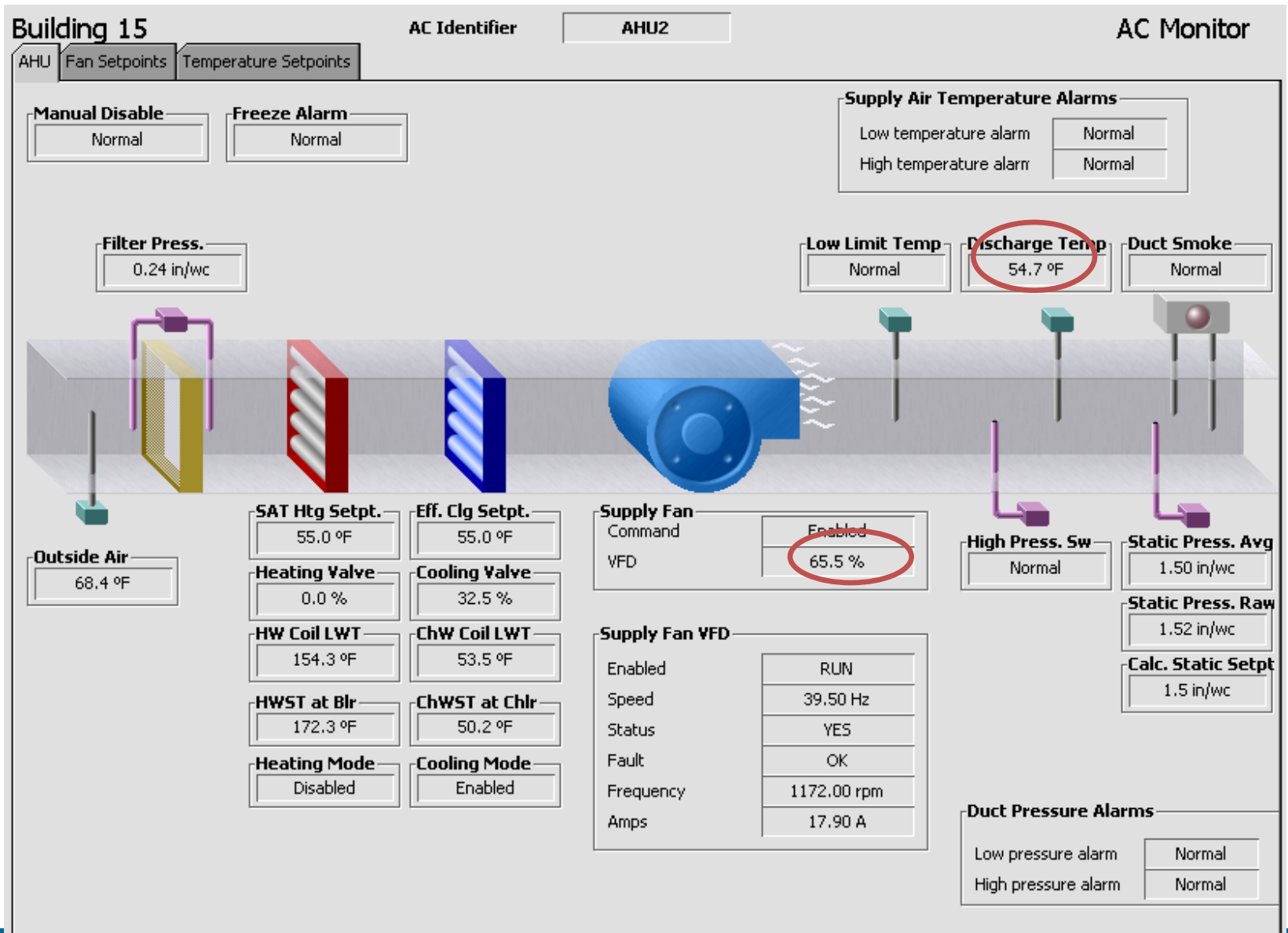
EF Identifier

EF1_2_3_4

Exhaust Fans



VFDs installed, opportunity?



Reheat in all zones, almost

Building 15

AH-1 VAV Summary

West Pod Office Zone Schedule

Flr 1 Office VAVs | Flr 2 Office VAVs | Flr 3 Office VAVs | Flr 1 Lab Zones | Flr 2 Lab Zones | Flr 3 Lab Zones

Room #	Zone Temp	Current Setpoint	Heating Valve	SA Flow	Damper	EA Flow
M1033	70.80 °F	71.00 °F	47.00 %	481.00 cfm	37.00 %	550.00 cfm
M1039_1039A_1037	71.00 °F	71.00 °F	57.00 %	785.00 cfm	0.00 %	1130.00 cfm
M1073	71.20 °F	71.00 °F	40.00 %	132.00 cfm	29.00 %	193.00 cfm
M1075	73.30 °F	71.00 °F	0.00 %	339.00 cfm	44.00 %	398.00 cfm
M1110	70.90 °F	71.00 °F	42.00 %	110.00 cfm	28.00 %	166.00 cfm
M1112	71.20 °F	71.00 °F	46.00 %	665.00 cfm	0.00 %	1101.00 cfm
M1114	71.00 °F	71.00 °F	40.00 %	585.00 cfm	8.00 %	1371.00 cfm

Building 15

AH-2 VAV Summary

West Pod Office Zone Schedule

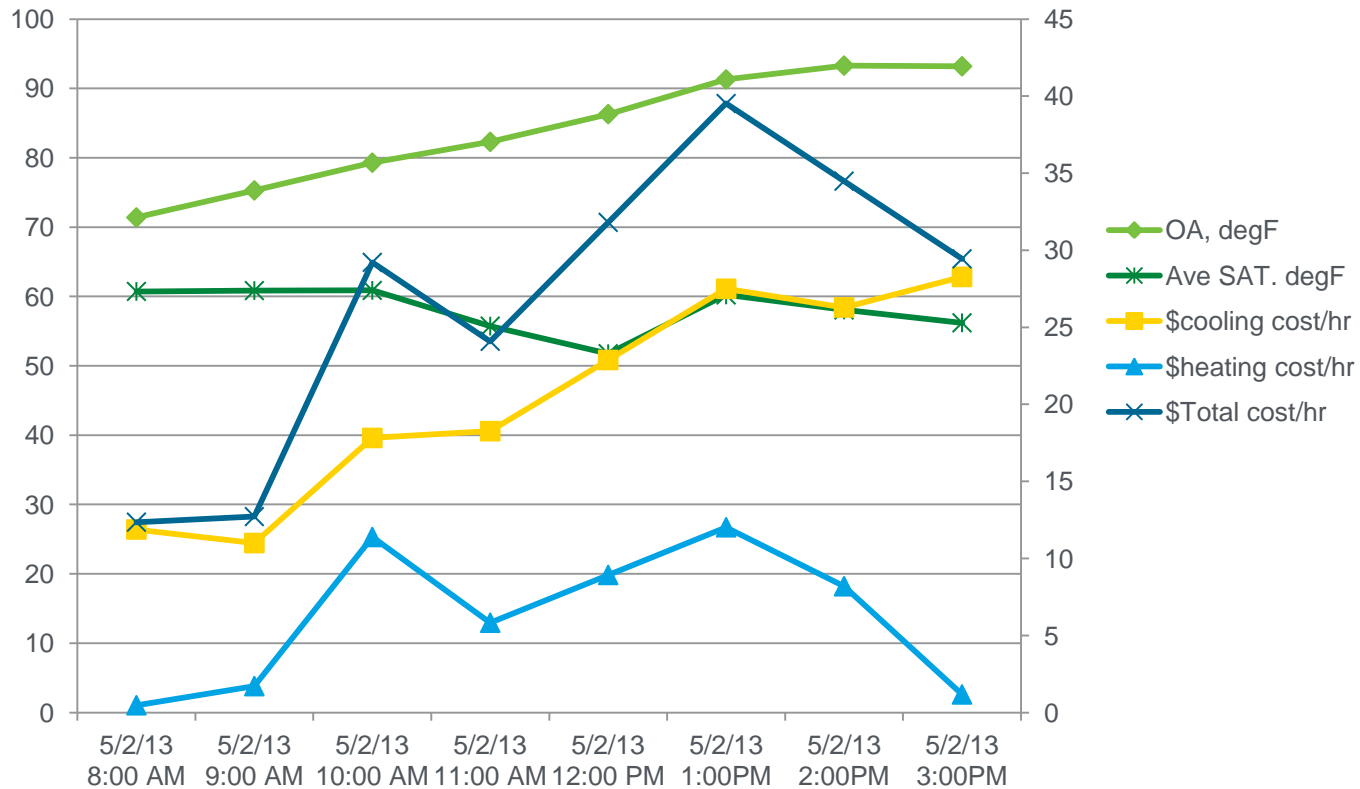
Flr 1 Office VAVs | Flr 2 Office VAVs | Flr 3 Office VAVs | Flr 1 Lab Zones | Flr 2 Lab Zones | Flr 3 Lab Zones

Room #	Zone Temp	Current Setpoint	Heating Valve	SA Flow	Damper	EA Flow
M2021_2021A	71.30 °F	71.00 °F	24.00 %	266.00 cfm	25.00 %	278.00 cfm
M2025	71.00 °F	71.00 °F	62.00 %	418.00 cfm	17.00 %	566.00 cfm
M2061	70.80 °F	71.00 °F	39.00 %	105.00 cfm	22.00 %	166.00 cfm
M2063	71.20 °F	71.00 °F	39.00 %	255.00 cfm	24.00 %	318.00 cfm
M2065	70.80 °F	71.00 °F	38.00 %	171.00 cfm	18.00 %	228.00 cfm
M2067A	70.80 °F	71.00 °F	0.00 %	174.00 cfm	28.00 %	176.00 cfm

Cost of reheat

OA Temp
degF

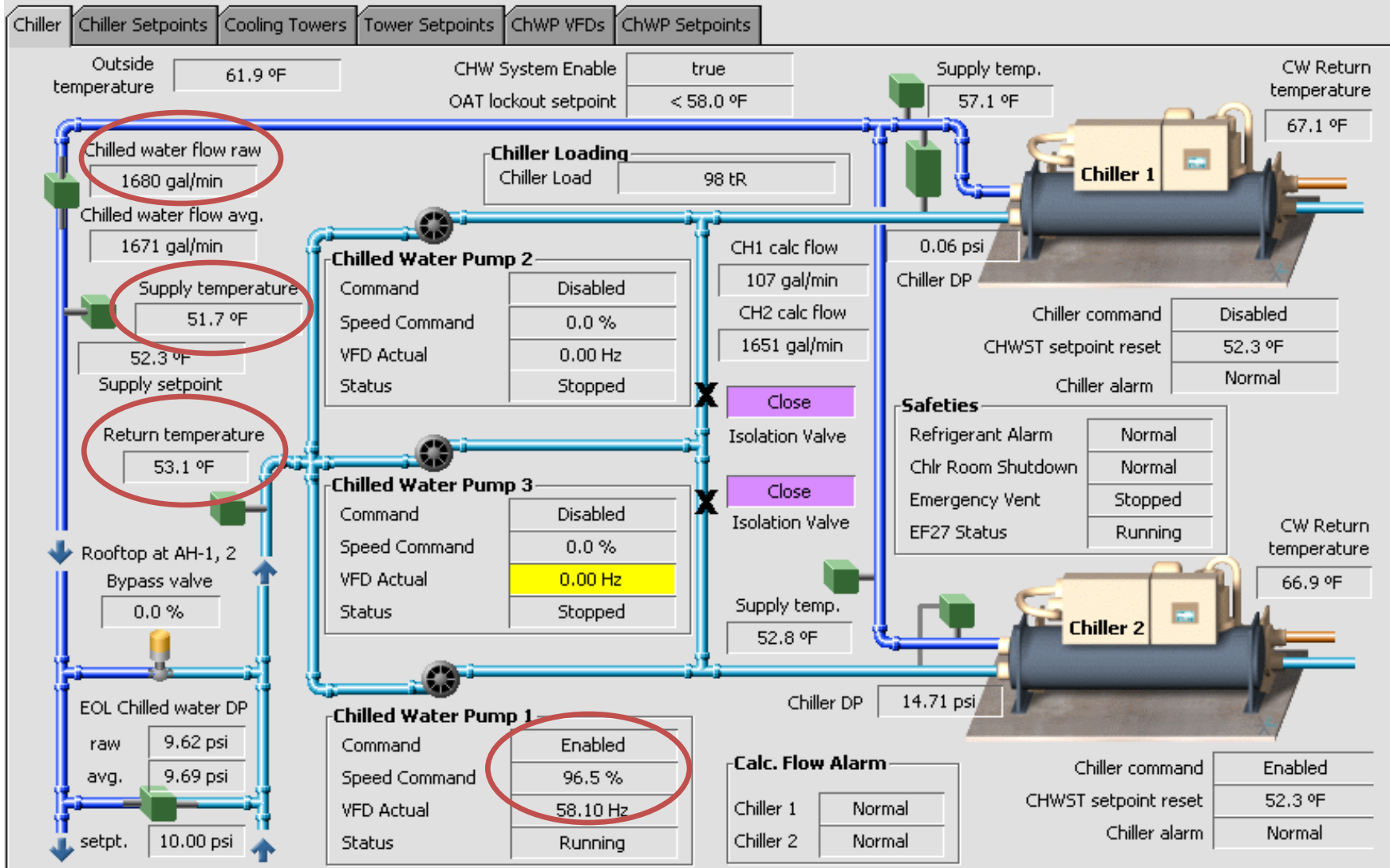
Utility Cost
\$/hr



Monitoring few others...

Building 15

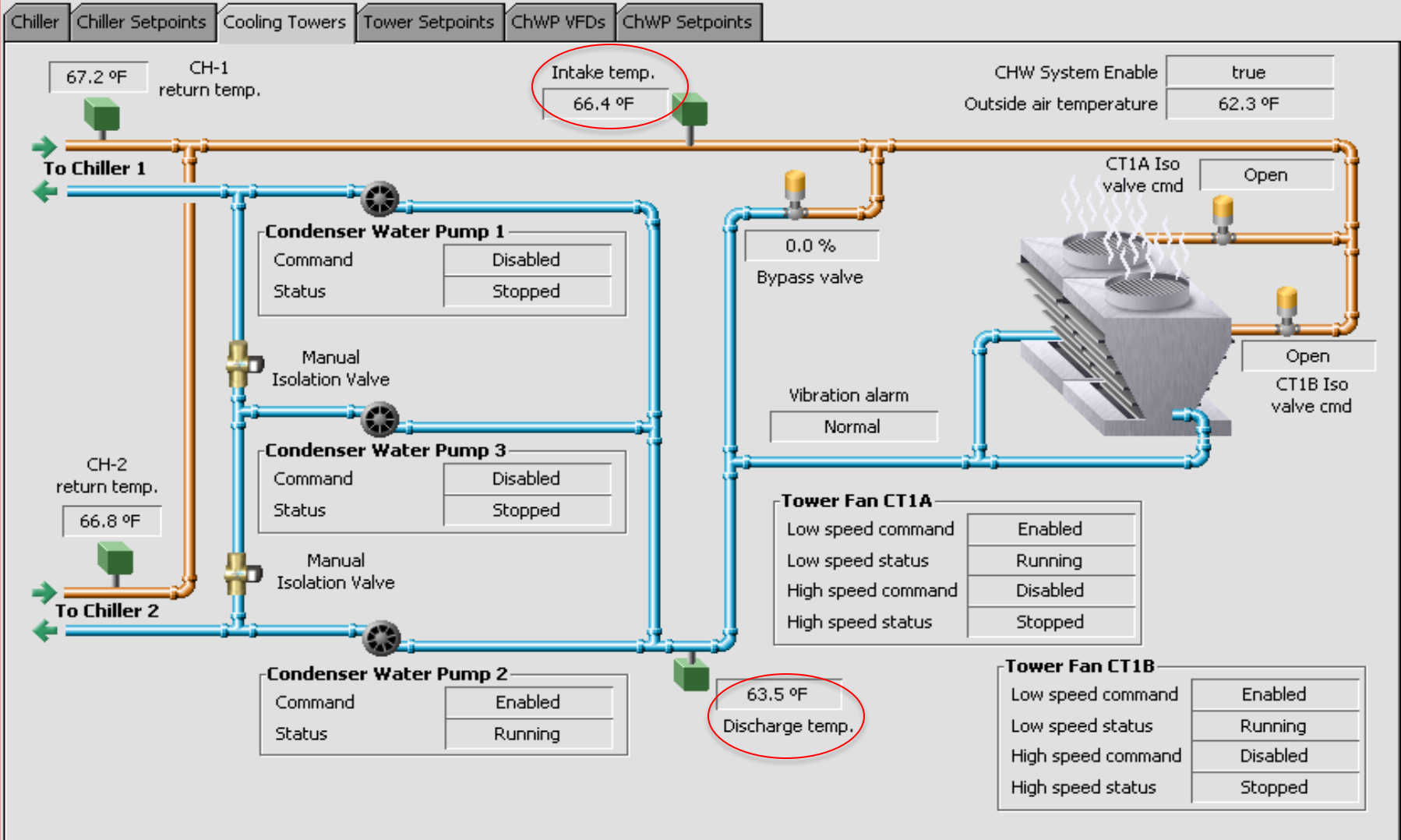
Chiller



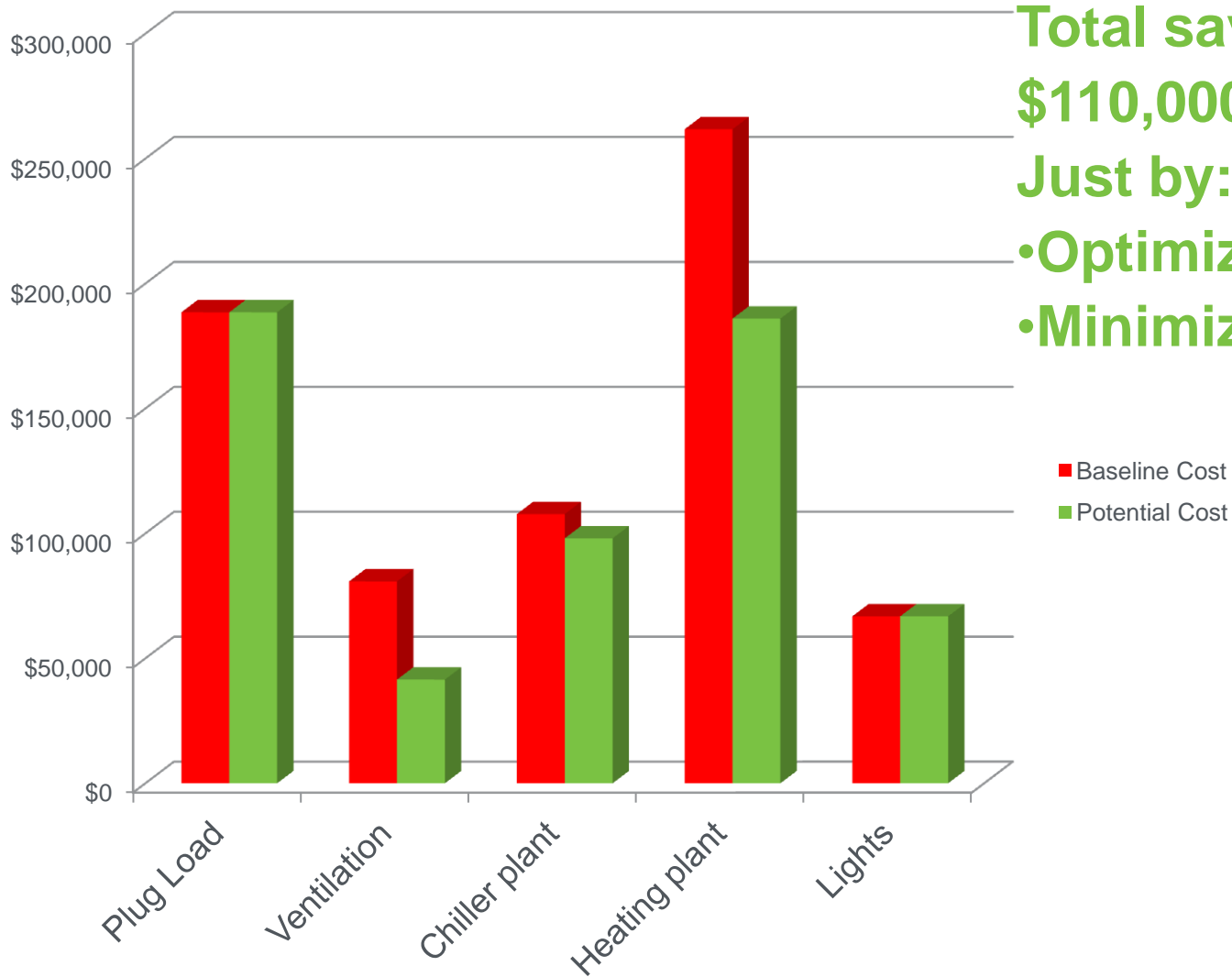
..and few more...

Building 15

Chiller



Current and potential utility cost



**Total saving of
\$110,000-\$180,000
Just by:**

- Optimize Ventilation
- Minimize Reheat



Questions?

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